

Current Status of Securing Category 1 and 2 Radioactive Sources in Taiwan

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Abstract

For enhancing safe and secure management of Category 1 and 2 radioactive sources against theft or unauthorized removal, AEC (Atomic Energy Council) of Taiwan have been regulating the import/export of the sources ever since 2005, in compliance with the IAEA's (International Atomic Energy Agency) "Guidance on the Import and Export of Radioactive Sources". Furthermore in consulting the IAEA Nuclear Security Series No.11 report, administrative regulations on the program of securing the sources have been embodied into AEC's regulatory system since 2012, for the purpose of enforcing medical and non-medical licensees and industrial radiographers to establish their own radioactive source security programs. Regulations require that security functions such as access control, detection, delay, response and communication and security management measures are to be implemented within the programs. This paper is to introduce the current status in implementing the security control measures in Taiwan.

Introduction

For enhancing safe and secure management of Category 1 and 2 radioactive sources against theft or unauthorized removal, AEC (Atomic Energy Council) of Taiwan have been regulating the import/export of such sources ever since 2005, in compliance with the IAEA's (International Atomic Energy Agency) "Guidance on the Import and Export of Radioactive Sources". Furthermore in consulting the IAEA Nuclear Security Series No.11 report, administrative regulations on the program of securing the sources have been embodied into the regulatory system since 2012, for the purpose of enforcing medical and non-medical licensees and industrial radiographers to establish their own radioactive sources security programs. The programs shall conform to the regulations in terms of security level and the underlying security functions: access control, detection, delay, response and communication, and security management. Such measures may include installing double barriers at source storage sites, controlling access key, intrusion alarming, installing closed circuit television (CCTV) monitoring system, remote alarm monitoring and so on. In addition, to track at any time the stored and shipped status of mobile radioactive sources, AEC have legislated that industrial radiographers (licensees) shall be obligated to equip dashboard cameras on the shipping vehicles, capable of clearly taping the whole process of loading, storing and transporting, those sources, so as to strengthen control of them en route. The following is to introduce Taiwan current status in implementing those security measures stipulated for managing Category 1 and 2 radioactive sources.

Following the threat of 911 terrorism, for preventing terrorists from using radioactive sources to make "dirty bombs", the IAEA approved the "Code of Conduct on the Safety and Security of Radioactive Sources" in September 2003, to request countries to strengthen the import and export controls on sealed high-radioactivity sources; and in September 2004, the IAEA further approved the supplementary "Guidance on the Import and Export of Radioactive Sources", to provide specific rules in the light of practicality on importing and exporting radioactive sources. Currently, Taiwan has in

total 306 Category 1 and 2 radioactive sources and 2 irradiation facilities (with 508 source rods in total). In response to the internationally accepted code of best practice, AEC have amended stipulations in relevant administrative regulations, for conducting effective control on Category 1 and 2 radioactive sources in use. AEC have further expanded their regulation to conduct special-tasked inspections to ensure radioactive source control, such audits are targeting sources at high risk for abandonment, or reuse and regulations are written to ensure safe disposal of such potential orphan sources. AEC have also been keeping cooperation relationships with advanced countries, so as to keep pace with the updated international trends of securing radioactive sources. The specific measures AEC took are described as the following:

1. Administrative regulations on radioactive sources security control

In line with the requests of the IAEA’s "Code of Conduct on the Safety and Security of Radioactive Sources" and "Guidance on the Import and Export of Radioactive Sources", AEC have consulted the TECDOC-1355 report and amended the “Administrative Regulations for Radioactive Material and Equipment Capable of Producing Ionizing Radiation and Associated Practice” in December 29, 2005, to request licensees possessing Category 1 and/or 2 radioactive sources to submit documents with a description of security measures they took to ensure Sources Security control. Such measures may include installing alarm lights, alarming alert devices, door locks, video cameras and so on, to which the display panel of a guard post was required to connect for displaying any alarm signals in real time. Moreover in January 2006, AEC wrote an email to the Director of the IAEA to express our positions that AEC would support and observe the internationally-agreed regulations associated with safety and security of radioactive sources.

In 2012, further in reference to the IAEA’s Nuclear Security Series No.11 report, AEC have embodied the updated security concepts for radioactive sources into the regulatory system, amending again the “Administrative Regulations for Radioactive Material and Equipment Capable of Producing Ionizing Radiation and Associated Practice” in January 16, 2012, to request licensees possessing sealed Category 1 and/or 2 radioactive sources to replace the submission of documents with a description of security measures they took by establishing their own security programs. The security programs shall comply with the requirements of security levels and the underlying functions as suggested in the Nuclear Security Series No.11 report. After the date of issuing the amended Regulations, licensees are required to finish the installation of their security system within a year. Table 1 shows the requirements of security levels and functions for the current Category 1 and 2 radioactive sources in Taiwan.

Security Functions	Security level of sealed Category 1 radioactive sources	Security level of sealed Category 2 radioactive sources
Access control (refer to Figure 1)	1. Swipe card reader shall be provided or personal identification shall be taken to control entrance and exit. 2. Key control.	1. Swipe card reader shall be provided or personal identification shall be taken to control entrance and exit. 2. Key control.

<p>Detect (refer to Figure 2)</p>	<ol style="list-style-type: none"> 1. Intrusion alarm system and CCTV systems shall be provided. 2. Radioactive sources shall be checked at least twice a week by a radiation detecting instrument or visual inspection. 3. Remote alarm monitoring and security patrols. 4. Personnel monitoring and control shall be required as the vehicle is temporarily stopped during the transportation of radioactive sources. 	<ol style="list-style-type: none"> 1. Intrusion alarm system and CCTV systems shall be provided. 2. Radioactive sources shall be checked at least once a week by a radiation detecting instrument or visual inspection. 3. Remote alarm monitoring. 4. For mobile radioactive sources, during transportation, the containers shall be fixed onto the vehicle and be locked. A real-time tracking system shall be equipped on the vehicle or container. 5. Vehicles loaded with mobile radioactive sources shall be equipped with anti-theft alarm system. 6. Personnel monitoring and control shall be required as the vehicle is temporarily stopped during the transportation of radioactive sources.
<p>Delay (refer to Figure 3)</p>	<ol style="list-style-type: none"> 1. Double barriers shall be provided. 2. Radioactive sources shall be stored in a dedicated storage vault and locked. 3. Control panel and operation tools for radioactive sources shall be locked with the keys kept by an authorized person. 	<ol style="list-style-type: none"> 1. Double barriers shall be provided. 2. Radioactive sources shall be stored in a storage vault and be locked. 3. Control panel and operation tools for radioactive sources shall be locked with the keys kept by an authorized person.
<p>Response and communication (refer to Figure 4)</p>	<ol style="list-style-type: none"> 1. Incident response personnel shall be appointed to handle security related incident of the radioactive sources. 2. Incident response personnel shall be informed by two or more methods of communication. Immediate response of personnel upon incident notification is required. 	<ol style="list-style-type: none"> 1. Incident response personnel shall be appointed to handle security related incident of the radioactive sources. 2. Incident response personnel shall be informed by two or more methods of communication. Immediate response of personnel upon incident notification is required.
<p>Security management</p>	<ol style="list-style-type: none"> 1. A facility operator who uses, ceases to use or possesses sealed radioactive material shall report to the Competent Authority within the first 15 days of each month on the status of use, cease of use or possession in the preceding month with regard to the said material. The report may be filed via the Internet. 2. Security system function test shall be 	<ol style="list-style-type: none"> 2. 1. A facility operator who uses, ceases to use or possesses sealed radioactive material shall report to the Competent Authority within the first 15 days of each month on the status of use, cease of use or possession in the preceding month with regard to the said material. The report may be filed via the Internet. 2. Security system function test shall

	<p>performed once each quarter.</p> <p>3. Security training shall be carried out once a year.</p> <p>4. Should there be any change in activity, quantity or workplace (storage area) of radioactive sources, re-evaluation is required to confirm whether the classification is consistent with requirements for the security levels and any change need AEC's approval.</p>	<p>be performed once semi-annually.</p> <p>3. Security training shall be carried out once a year.</p> <p>4. Should there be any change in activity, quantity or workplace (storage area) of radioactive sources, re-evaluation is required to confirm whether the classification is consistent with requirements for the security levels and any change need AEC's approval.</p>
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Table 1. The requirements for security levels and their functions of sealed Category 1 and 2 radioactive sources



Figure 1. Access Control–Swipe card reader to control personal entrance and exit



Figure 2. Detection system – monitoring screen of all areas



Figure 3. Delay system – locked-up storage cabinet dedicated for radioactive sources



Figure 4. Response and communication – informing via remote camera monitoring system

2. Taking administrative control measures for radioactive sources

As safely and reliably managing high-risk radioactive sources is essential, it is very important to study the policy subject that plans national long-term security control measures for those high-risk sources. To establish and maintain the underlying framework for administrative control system of sources, AEC have adopted an expedient multi-agency cooperation scheme as the framework basis, and introduced computerization with an online interface to construct the system for implementation and facilitation of control measures. Through the system, AEC have been requesting that licensees possessing sealed radioactive sources shall declare the updated status of their sources on a monthly basis, so that the dynamic situation of those sources can be effectively tracked and controlled. Besides the measure, AEC have also been implementing yearly special-tasked inspections for higher-risk Category 1 and 2 radioactive sources. Under the inspections, licensees are requested to establish their own self-managing program for security of sources. Onsite auditing of source status is another essential requirement of the AEC requirements.

2.1 Administrative e-control system for tracking dynamic situation of radioactive sources

Since 2007, AEC have established online control measures as shown in Figure 5 in the administrative e-control system. Through the e-system, AEC have requested 800~1000 licensees possessing sealed radioactive sources to declare the updated status of their sources on a monthly basis. If licensees do not declare source status as requested, a phone-tracking system will be activated to remind them of completing the declaration process duly. If the tracking phone call fails to produce the desired source status response, AEC personnel will be actively responsible investigate the sources status. In the case that there are no radiation safety concerns, the sources will remain subject to non-scheduled tracking supervision, the frequency of which is once or twice per year. When failure to comply with AEC requirements indicate safety concerns, AEC will obtain the custody of those sources order to protect the environment and ensure radiation safety of the general public.

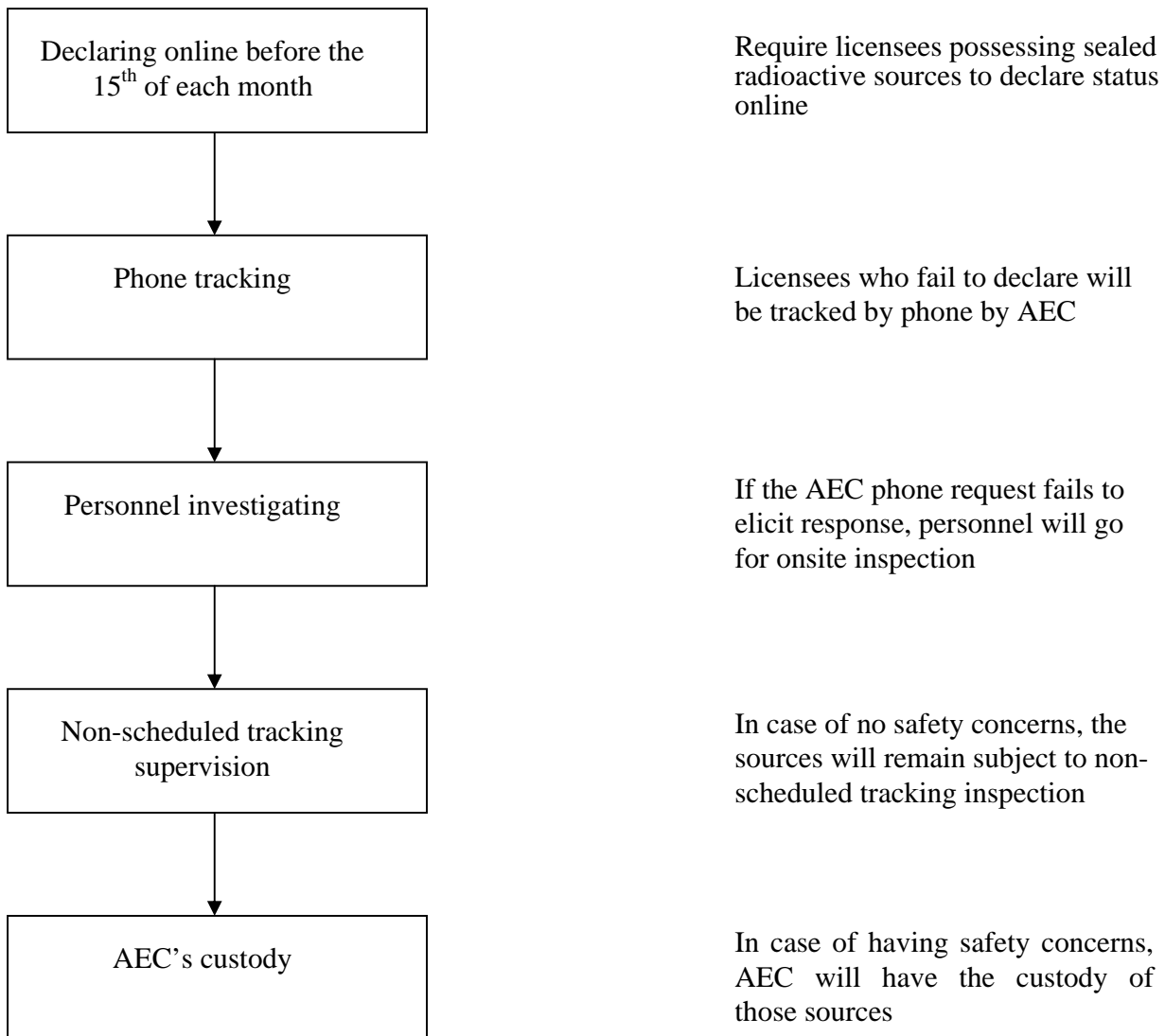


Figure5. Computerized control measures for radioactive sources

2.2 Yearly special-tasked inspections on radioactive sources

For promoting the safety control policy on high-risk radioactive sources and strengthening associated measures, AEC have approved a special-tasked assistance and inspection program according to Article 11 of Ionizing Radiation Protection Act, under which AEC would annually execute source audits and inspections on Category 1 and 2 sources, The licensees are required to establish their own self-managing program, and to direct/strengthen licensees' expertise through training as well as develop capabilities in the field to ensure radiation protection and source security. In the special-tasked inspections, AEC emphasize compliance to the associated documents by reviewing documentation and performing onsite source auditing. The inspection flow chart is displayed in Figure 6.

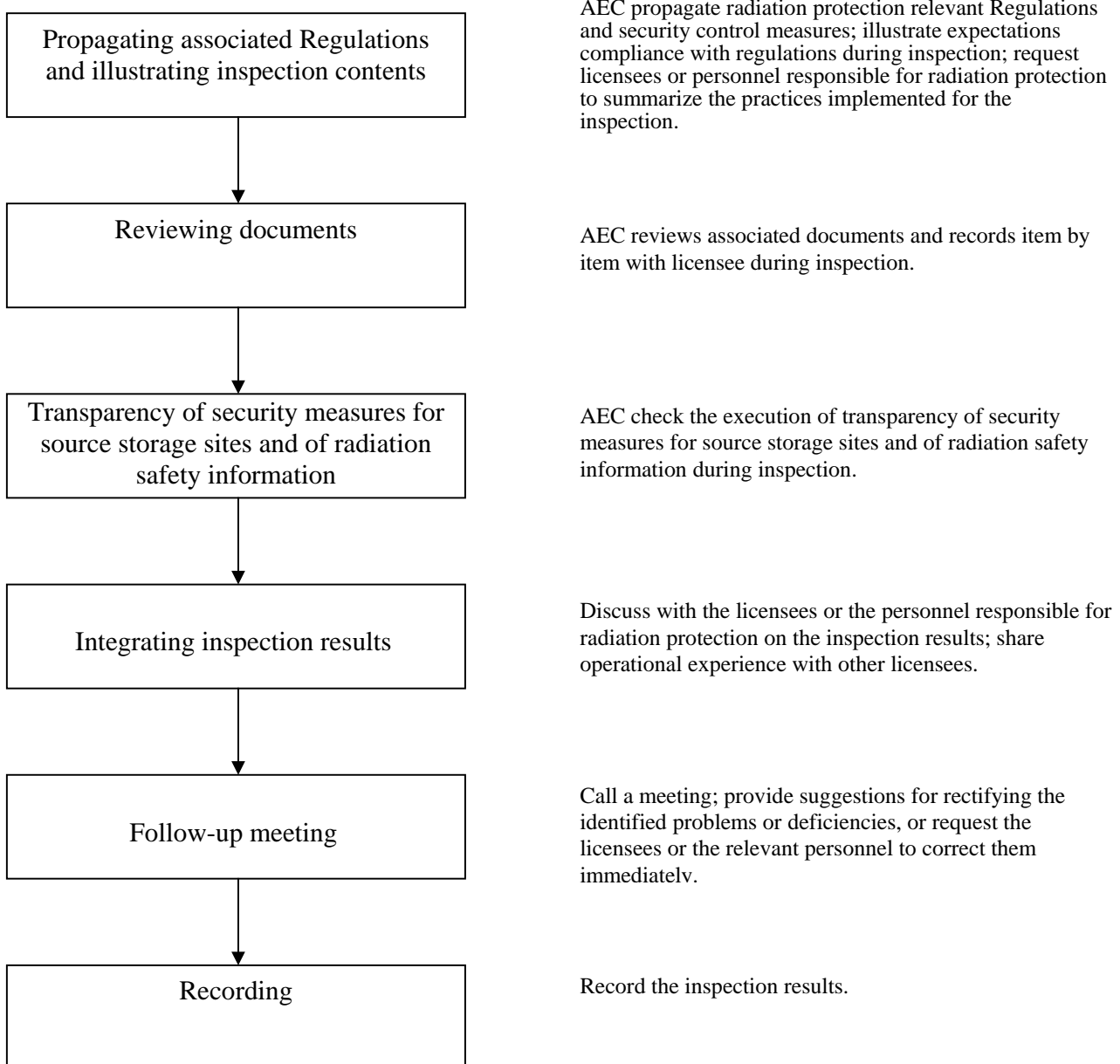


Figure 6. Flow chart describing the process for a special-tasked inspection for radioactive sources.

In the special-tasked inspections executed in 2013, AEC had inspected 83 licensees and the installation of equipment/system(s) and the operation of the measures for source security were found completed.

The inspection and follow-up re-inspection results were summarized as the following:

- 1 All the licensees have already established their radiation protection program.
- 2 All the licensees have made their source inventory checking documents for recording actual importing/exporting details, and regularly renewed them.
- 3 All the licensees have monthly declared their sealed radioactive sources online as requested.
- 4 All the licensees have the permit approved by AEC for the permission of importing/exporting radioactive sources as requested.
- 5 All the radiation detectors in use have had effective calibration records as requested.
- 6 The 95% of the licensees had installed proactively the security equipment/system(s) with video monitoring devices and/or personnel identification access control, etc.
- 7 Transparency of radiation safety information has been implemented; the displayed contents were comprehensive and essential to radiation workers and/or the general public.
- 8 Source containers and storage room(s)/vault(s)/cabinet(s) have been clearly labeled with essential information, and easily recognized.

3. Establishing a mechanism for orphan sources' prevention

In 1992, an incident of radio-contamination of steel bars for building construction occurred in Taiwan. After investigation, the incident was found caused by contamination by an orphan Co-60 source, which was mistakenly added to feedstock in a furnace of a steel mill. To prevent recurrence of such incident, AEC have required 19 domestic steel mills to install portal type radiation detectors (shown as Figure 7) in the entrance to screen orphan sources in the scrap metal into/out of the mills.



Figure 7. Portal type radiation detector in a steel mill

In Figure 8, the annual statistical results of nuclide sort analysis by MCA (multi-channel analyzer) as well as number of pieces found for the abnormal radioactive materials arrested from the prevention mechanism revealed that NORM (naturally occurring radioactive materials) had 583 events and dominated the most (72%), artificial nuclides had 226 events (28%). Since the inception of the prevention mechanism in 1995, AEC have proved that orphan sources could be effectively prevented from entering steel making process.

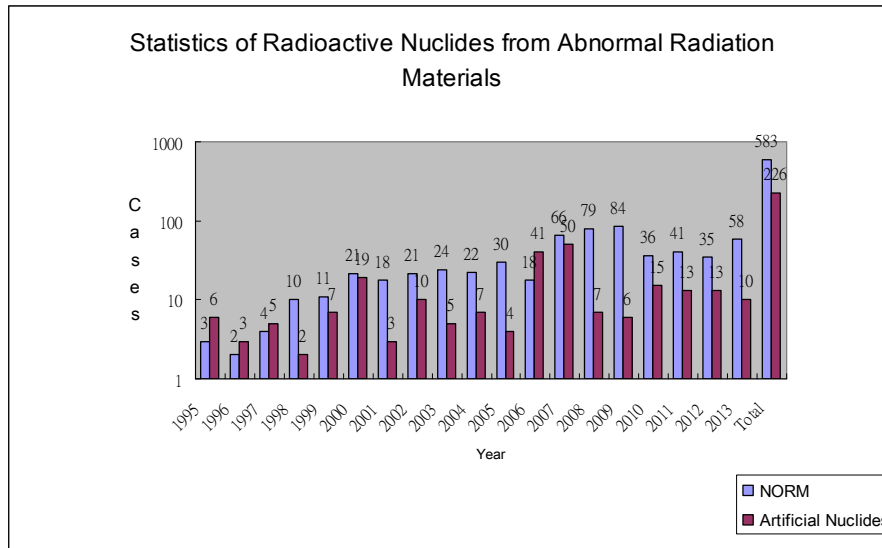


Figure 8. Statistics of radioactive nuclides from abnormal radioactive materials found from the prevention mechanism of the Customs and steel mills

4. Strengthening control on mobile sealed radioactive sources

Taking account of that mobile sealed radioactive sources, especially Ir-192 projectors used in industrial radiography, are small in size and well shielded, they were considered might be easily stolen by malicious people if there were no security control measures. Therefore, AEC once tried to equip a GPS (Global Position Satellite) device onto an Ir-192 projector in transportation, in order to test the real-time tracking function of recording dynamically-changing locations en route. The test was for the evaluation of the feasibility that taking the measure of using GPS devices to effectively control mobile sources; however, the test results showed not satisfactory. In order to know exactly the dynamic situation of those sources en route, namely storage status or being-taken-away status, etc., AEC have requested industrial radiographers to equip dashboard cameras instead (seeing Figure 9) for monitoring the status of the shipped sources. This is the measure taken in Taiwan for controlling mobile radioactive sources.



Figure 9. Dashboard cameras attached to a vehicle shipping the mobile radioactive sources

Conclusion

AEC will continuously propagate the successful experiences on the promotion of various control measures for safety and security of Category 1 and 2 radioactive sources. AEC's experiences are proving that applying computerization for administrative control and establishing the orphan source prevention mechanism, etc., are effective measures, capable of not only preventing orphan sources from entering steel making process, but of knowing exactly dynamic situation of the declared sources in Taiwan, so that those sources are able to be prevented from theft or unauthorized removal, further averting occurrence of radiation incidents, and ensuring radiation safety of the general public. With acknowledgements, AEC would like to take the PBNC occasion to share our experiences on the implementation of security control measures for Category 1 and 2 radioactive sources.